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STUDIES ON THE DERMESTOIDEA (COLEOPTERA), WITH SPECIAL REFERENCE TO THE NEW ZEALAND FAUNA

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(*University of Glasgow*)

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With 17 Text-figures

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I. Introduction

As originally proposed by myself in 1951, the Dermestoidea corresponded to Meixner's (1938) Byrrhida minus its type family Byrrhidae, with the addition of Thorictidae; in 1955 (Crowson) the family Sarothriidae (= Jacobsoniidae) was added to it. The superfamily thus constituted seems to occupy a peculiarly central and primitive position among Polyphagan beetles; the problem of its relationships is one involving the most profound mysteries of Coleopterous phylogeny. In dealing with some of the very interesting New Zealand representatives of the Dermestoidea, I have been obliged to reconsider the fundamental characters and affinities of the group; a discussion of these subjects is however postponed to the later part of this paper, after an account of the New Zealand forms.

II. The New Zealand Dermestoidea

(1) Derodontidae

Some years ago (1951), in dealing with the characteristics and relationships of this family, occasion was taken to remark on its unusual geographical distribution (Derodontids were then known only from the Holarctic region), and a prediction was ventured that representatives might eventually be found in the Southern hemisphere. At the end of 1956, while studying in Nelson (New Zealand), I had occasion to examine some unidentified Coleoptera in the collec-

tion of Mr. E. S. Gourlay, of the D.S.I.R. Entomology Division there, and detected a single specimen of an undoubted Derodontid. Later, with the kind assistance of Mr. Gourlay, I was able to visit the locality from which his specimen came; there and elsewhere in the South Island I was eventually able to find numerous specimens of the new Derodontid, and also to discover something of its habits. In general features the New Zealand species shows most resemblance to the Holarctic genus *Derodontus*, but can hardly be included in it; it has been necessary to define a new genus, which can be distinguished from the other known genera of Derodontidae by the following key:

1 ADULT: tarsi with segments 2–3 strongly lobed below, segment 4 small; upper surface with outstanding bristles; abdominal sternites with characteristic deep pouches at their lateral margins. LARVA: abdominal segment 9 not bearing distinct urogomphi; mandibles without an asperate molar part. Holarctic species, predatory on Chermesids (Franz, 1958) . . . . . **Laricobius** Rosenh.

– ADULT: tarsi with segments 2–3 not or slightly lobed below; upper surface glabrous or with fine recumbent pubescence; abdominal sternites without deep pouches at their lateral margins. LARVA: abdominal segment 9 bearing paired urogomphi; mandibles with well-developed asperate molar part. Species feeding on fungi or Mycetozoa 2

2 ADULT: prothorax with sides very broadly explanate, not dentate; dorsal ocelli small, round, very distinct; head with pronounced grooves below eyes for reception of antennae; last tarsal segment longer than preceding 4 together. LARVA: not described. Holarctic species . . . . . **Peltastica** Mannerheim

– ADULT: sides of prothorax not broadly explanate, more or less dentate; dorsal ocelli replaced by irregularly shaped semi-transparent tubercles; head without distinct grooves for reception of antennae; last tarsal segment shorter than preceding 4 together 3

3 ADULT: elytra with 11 complete impressed striae, no short scutellary striole; tarsal segment 4 much narrower than 3; upper surface with fine recumbent pubescence; 2 basal segments of antennae dull, densely covered with sensillae; abdominal sternites 2–3 without median impressions. LARVA: head with 5 ocelli, characteristically arranged, on each side (fig. 2); antennal segment 2 more than twice as long as wide. New Zealand species . . . **Nothoderodontus** gen. n.

– ADULT: elytra with 10 complete striae and a short scutellary striole; tarsal segment 4 not much narrower than 3; upper surface glabrous; 2 basal antennal segments bearing only a few setae; abdominal sternites 2–3 with characteristic median impressions. LARVA: head with 6 ocelli on each side; antennal segment 2 less than twice as long as wide. Holarctic species . . . . . **Derodontus** Leconte

Nothoderodontus gen. n.

In addition to the characters given in the key, the genus may be defined as follows:

Eyes lateral, rather prominent, almost circular in outline when seen from the side. Antennae with segments 1–2 about equal in size, about as long as wide and much wider

than 3–8, segments 9–11 forming a loose elongate club. Labrum rather large, transverse, front margin evenly convex. Mandibles with bidentate apex, with a large membranous prostheca and asperate molar part. Maxillae with galea brush-like at apex; palpi 4-segmented without a distinct palpiger, last segment longer than preceding 2 together but little wider than them. Labial palpi 3-segmented, last segment much larger than preceding ones. Clypeus distinct, transverse, its front and hind margins almost straight. Vertex with a pair of deep impressions behind and slightly mesad of antennal insertions (fig. 1), and with a pair of semi-transparent tubercles adjacent to inner posterior borders of eyes; occiput distinctly constricted immediately behind eyes. Prothorax with a distinct lateral margin throughout, the margin not at all explanate, somewhat angularly protuberant in middle of sides (fig. 1). Scutellum rather small, more or less semicircular. Elytra with disc slightly transversely impressed at the level of about one-fourth the way down the suture; interstices 2, 4, 6, and 8 ending well before 1, 3, 5, 7, and 9; the 3 outermost striae with their extreme bases deepened to form characteristic pits. Aedeagus of simple trilobe type, much shorter than that of *Derodontus*. Met-endosternite similar to those of *Peltastica* and *Derodontus* (Crowson, 1944). Metasternum with a pair of deep pits on each side of its front margin, immediately behind middle coxae.

Type species *Nothoderodontus gourlayi* sp. n.

Nothoderodontus gourlayi sp. n.

Derm brownish to almost black, unicolorous, somewhat shining. Head with impressions dorsally as figured (fig. 1); vertex shining, with rather long, fine pubescence, punctuation very fine and sparse. Pronotum rather irregularly punctured with large punctures of varying sizes, particularly large ones on middle line about one-third from the base; the interstices very finely punctured and pubescent; a rather distinct line of large punctures immediately before hind margin; sides of pronotum somewhat impressed before and behind the lateral protuberance. Pubescence of pronotum mostly directed posteriomedially; that of elytral interstices rather shorter and finer, directed posteriorly; striae weakly but distinctly punctate, interstices with very fine sparse punctures.

Length of holotype, fully extended, 2 mm.; maximum width of pronotum 0·56 mm., maximum width of elytra 0·9 mm., length of elytra along suture 1·48 mm.

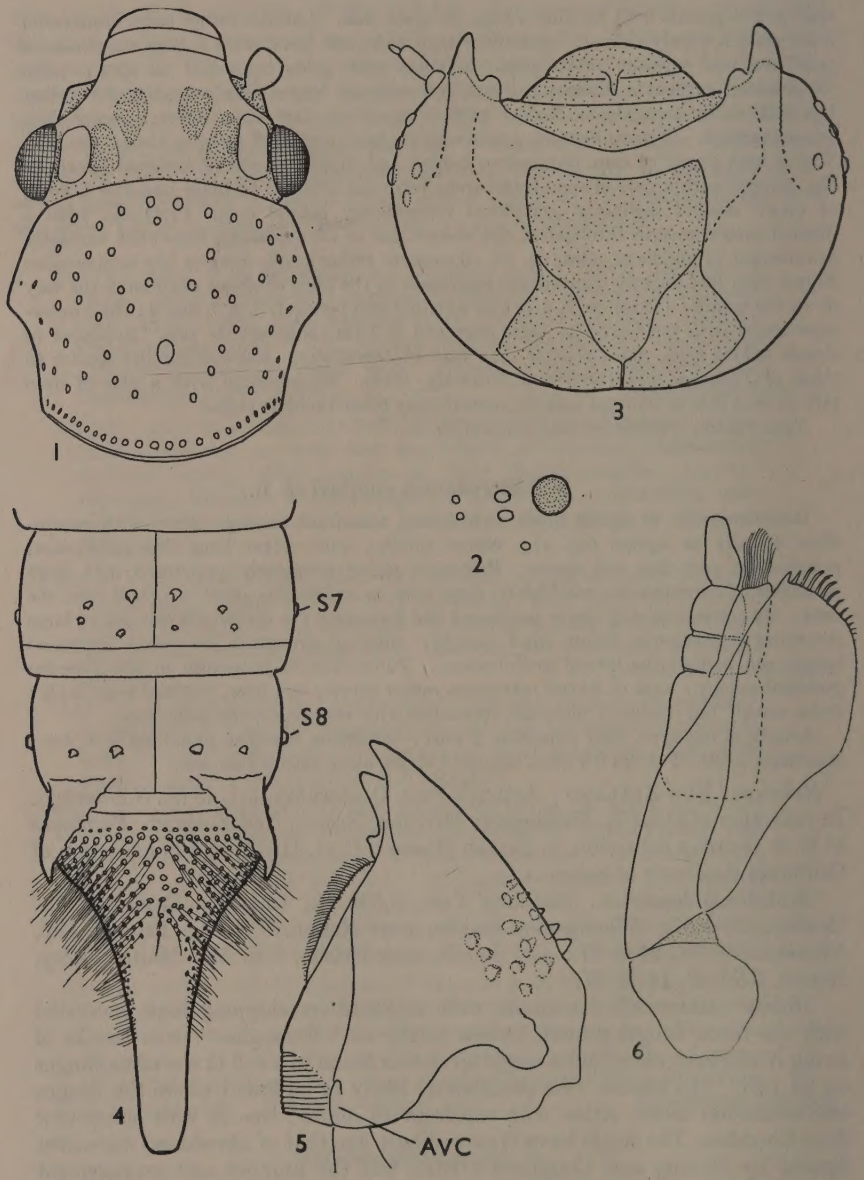
Holotype. New Zealand; Arthur's Pass, Canterbury, 3.i.43 (*E. S. Gourlay*). In collection of D.S.I.R. Entomology Division, Nelson, New Zealand. *Paratypes* in E. S. Gourlay collection, in British Museum (Nat. Hist.), and in collection of California Academy of Sciences.

Additional localities: Arthur's Pass, 2,500 ft., 10.i.57; Capleston, nr. Reefton, 22.i.57; Whangamoa Saddle, near Nelson, 5.ii.57; Fringed Hill, Nelson, 2,500 ft., 21.ii.57; Rai Saddle, near Nelson, 2.iii.57; Maitai Valley, Nelson, 3.iii.57, 14.iii.57.

Habits. Almost all the adults were collected by chipping bark encrusted with the black fungal growth known locally as "Fumagine" from trunks of living *Nothofagus* trees, and a single larva was found in a cell in the same fungus on 22.i.57. The beetles were particularly likely to be found where the fungus was somewhat moist, either with sap from an injured tree or with honey-dew from Coccidae. The single larva is exceedingly like that of *Derodontus maculatus* figured by Boving and Craighead (1931), but the number and arrangement of the ocelli is apparently different in *Nothoderodontus* (fig. 2).

(2) Nosodendridae

Broun (1880) remarked of one of the two species of this family recorded from New Zealand, "The insect might very well form the type of a second



FIGS. 1–6.—(1)–(2) *Nothoderodontus gourlayi* sp. n.: (1) head and prothorax, dorsal view; (2) arrangement of larval ocelli (antennal socket dotted). (3)–(6) *Nosodendron ovatum* Broun: (3) larva, head capsule in ventral view, mouth-parts removed; (4) end of abdomen, dorsal view; (5) left mandible, ventral view; (6) left maxilla, ventral view. (*AVC*, accessory ventral condyle (ventral crushing tubercle of Van Emden); *S7*, *S8*, spiracles of abdominal segments 7 and 8).

genus of this subfamily". I did not meet with adults of the species in question (*Nosodendron ovatum* Broun), but found a single Nosodendrid larva in the North Island which seems likely to belong to it—and if so will provide startling confirmation of Broun's suggestion. However the basis for a generic separation of *N. ovatum* on imaginal characters is not immediately obvious, and it cannot be taken as certain that the above-mentioned larva belongs to the species. Hence it seems premature to define a new genus at this stage. The known New Zealand Nosodendrids may be separated by the following key:

ADULT: elytra with no trace of striae, clothed with fairly evenly spaced short erect bristles; general form shorter and broader; antennae with segments of club very transverse; stridulating area on the gula indistinct; tibiae very much broadened. LARVA (?): general form more or less cylindrical; seventh abdominal tergite produced posteriorly into urogomphi-like processes (fig. 4); head (fig. 3) with distinct short epicranial suture, markedly deflexed. North Island species **Nosodendron ovatum** Broun

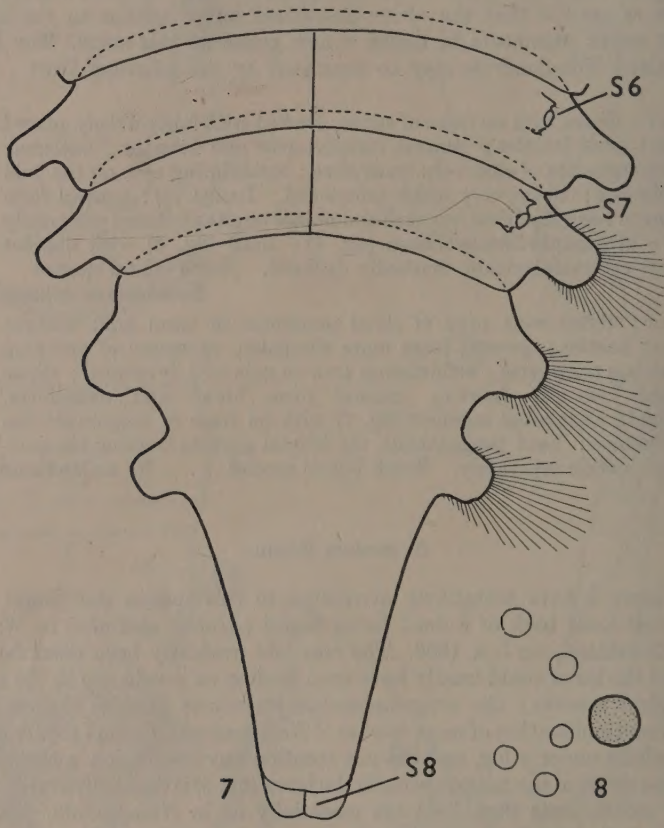
ADULT: elytra with rows of strial punctures in basal half, without erect bristles; general form more elongate; segments of antennal club less transverse; stridulating area on gula well developed; tibiae rather narrow. LARVA: general form broad and onisciform, seventh abdominal segment (fig. 7) with no trace of urogomphi-like structures; head prognathous, the frontal sutures meeting the occipital margin separately. South Island species . **N. zealandicum** Sharp

N. ovatum Broun

The larva I have tentatively attributed to this species was found under fairly moist loose bark of a dead fallen Kauri (*Agathis australis*) in Waipoua Forest, Northland, on 5.x.1956. The tree had evidently been dead for some years and the larva could hardly have been feeding on rancid sap in the normal Nosodendrid manner; the urogomphus-like structures likewise suggest a subcortical habit unlike that of most species of *Nosodendron*. Broun (1880) reported finding adults under a log, and did not mention any association with wounded trees. The shape of the head-capsule in the larva (fig. 3) is decidedly Byrrhid-like, but the mouth-parts (figs. 5–6) are essentially as in *Nosodendron*. The first seven pairs of abdominal spiracles are not raised on tubes to the extent that they are in other *Nosodendron* larvae, and the segments themselves, like the thoracic ones, are more or less cylindrical and without lateral outgrowths, with well-sclerotized and characteristically sculptured tergites. The ventral surface of the abdomen, though pigmented and sculptured (like all the intersegmental membranes), shows no defined sclerites such as are present on the dorsal surface. The eighth abdominal segment (fig. 4) is not conical as in other *Nosodendron*, but has a broad basal third, after which it is curvilinearly contracted to form a narrow tubular outgrowth with the spiracles at its end; the dorsum bears a dense dorso-lateral brush of bristles in the region where it is contracted. The peculiarities of this larva would appear to be caenogenetic rather than ancient; it is probably descended from a normal *Nosodendron* larva which forsook the typical mode of life of the genus.

N. zealandicum Sharp

The larva of this species differs from other described larvae of *Nosodendron* (*N. fasciculare*, *N. californicum*, *N. unicolor*) in having the lateral setal tufts of the thoracic and abdominal segments on very distinct blunt outgrowths



FIGS. 7–8.—(7) *Nosodendron zealandicum* Sharp: larva, end of abdomen, dorsal view; (8) *Hexonodes vulgatus* (Broun): larva, arrangement of ocelli (antennal socket dotted). (*S6*, *S7*, *S8*, spiracles of abdominal segments 6, 7 and 8.)

(fig. 7); it also has the spiracles on abdominal segment 1 much larger than those on 2–7. Adults and larvae were found in residues of rancid sap on an injured Rimu tree (*Dacrydium cupressinum*) at Pukekura, near Ross, Westland, on 14.i.57; adults without larvae were found on a similarly damaged Rimu tree in the upper Maitai valley, Nelson, on 12.ii.1957.

(3) DERMESTIDAE

The endemic New Zealand Dermestids represent only two of the six subfamilies of this extensive group—the Trinodinae, exemplified by *Hexanodes*,

and the Anthreninae, with the species of *Trogoderma* (*Psacus* auctt.). *Brounia*, concerning which I hope to say more elsewhere, is certainly a Ptilodactylid and nothing to do with Dermestidae or Dermestoidea. The introduced species of *Dermestes*, *Anthrenocerus*, *Anthrenus*, etc. are very rarely met with in the native bush of New Zealand.

Hexanodes vulgatus (Broun)

(*Ochina vulgata* Broun, *Hexanodes hudsoni* Blair)

Single adults were met with in mixed leaf-litter on the Western Hills, Whangarei, Northland, on 23.xi.56, and by beating an Asteliad on a rocky slope near the Reservoir, Nelson, on 2.ii.57. A pupa and cast larval skins had been collected in the same habitat at Nelson on 20.xii.56. Blair (1941) reported that Hudson had reared adults from larvae found in leaf-litter at Karori, near Wellington. The larva of *Hexanodes* has characters similar to those of the North American *Apsectus* (Boving and Craighead, 1931; Rees, 1943) and the Palaearctic *Trinodes* (Hinton, 1945; Kurosawa, 1937), but differs from both in having the setae of the thorax and abdomen relatively shorter (in which respect it approaches *Thylodrias*), and in having five lateral ocelli differently arranged (fig. 8). The pupa, largely enclosed in the last larval skin, has a characteristic vestiture of long stiff setae (similar to those of the larva) on the tergites of the thorax and the first three abdominal segments, which are not covered by the larval skin. It appears to have a "gin-trap", similar to those described from other Dermestidae by Hinton (1946) between the metathorax and first abdominal tergite.

Trogoderma sp. (?*Psacus* Pascoe)

Larvae of Dermestids of this type were met with in a number of localities in cavities and under rather dry bark, chiefly of Podocarps (especially Rimu); an adult was reared from one of them. The larvae would trace to *Trogoderma* in Hinton's key, as would the adult.

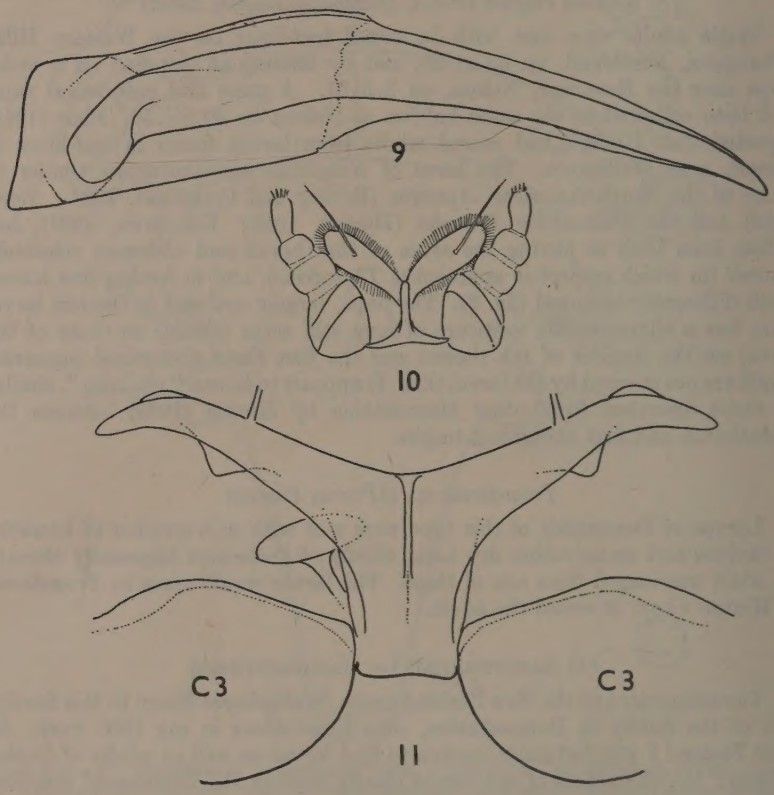
(4) Sarothriidae (= Jacobsoniidae)

The assignment of the New Zealand genus *Saphophagus* Sharp to this family, and of the family to Dermestoidea, were innovations in my 1955 work. In New Zealand I was fortunate enough to find larvae as well as adults of *Saphophagus*; the characters of the larvae clearly confirm the Dermestoid relationships deduced from the structure of the adults, but until the larva of *Sarothrias* Grouv. (= *Jacobsonium* Heller) is found, some doubt may persist concerning the relationship of *Saphophagus* to it. The last-mentioned genus is certainly one of the most remarkable of New Zealand's endemic insects, and might well be a relict coeval with *Sphenodon*.

Saphophagus minutus Sharp (*ferrugineus* Broun)

I have examined a considerable number of specimens of *Saphophagus* from various parts of the South Island of New Zealand (as far as I am aware it has not yet been found in the North Island) without discovering any way in which more than one species could be distinguished among them. The adult is well

figured by Sharp (1886). All the adults and larvae found by me were under more or less moist and close-fitting bark of dead trees, either *Nothofagus* spp. or (in one instance only) *Laurelia novae-zealandiae* (Pukatea). Localities were: in the vicinity of the Dun Mountain Track, Nelson, near the 2000 ft. contour; on the plateau of Takaka Hill (west of Nelson) at about 2500 ft.; at Arthur's Pass (near the Canterbury-Westland border) at a similar altitude; and near



FIGS. 9–11.—*Saphophagus minutus* Sharp: (9) aedeagus; (10) adult, distal part of labium; (11) adult, metendosternite. (*C3*, hind coxa).

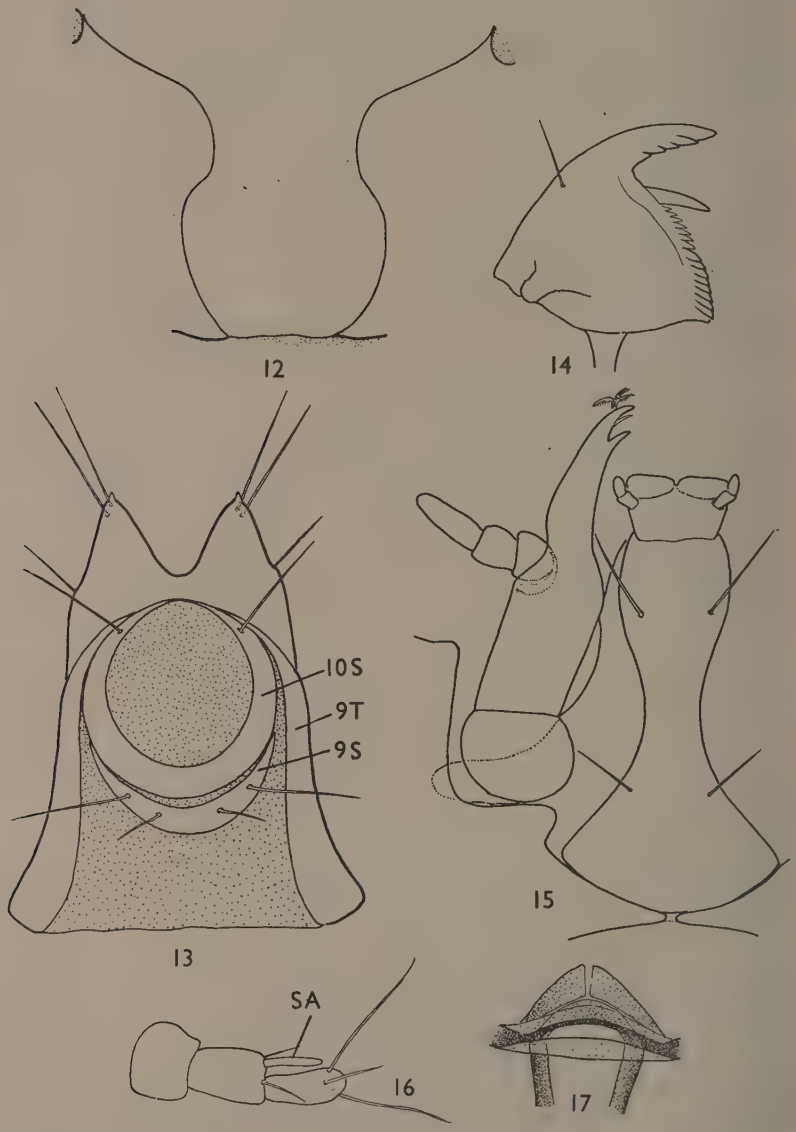
sea level at Mangarakau, near Westhaven, in the far NW. of the South Island, where the beetles occured under Pukatea bark in a rather subtropical kind of rain-forest more typical of the North Island. In most of the adult habitats and all the larval ones, the subcortical layer was more or less dark-coloured; associated species included *Picrotus thoracicus* (several times) and *Lenax mirandus* (twice, both with *Saphophagus* larvae). Pupae were never found, nor were the larvae reared through to adults, so that the identification of the

larvae is based only on habitat association and systematic characters. However, this type of larvae was found *only* in association with strong colonies of adult *Saphophagus;* any other associated adult beetles were also met with in other areas where *Saphophagus* did not occur, and I had been able to associate quite distinct larval types with most of them. The determination of the larvae as *Saphophagus* can therefore claim at least a high probability.

The larvae are very small (length up to about 1·9 mm.), slender and cylindrical in general form, of a uniform brown colour dorsally, and very slow moving; the general appearance from the dorsal side is perhaps suggestive of a diminutive *Hypophloeus* larva, though the cleavage of the ninth tergite into urogomphus-like processes will immediately separate it from the latter genus, and the completely membranous ventral side is not paralleled in any Tenebrionidae. The head is short, little deflexed, with the frontal sutures shaped much as in Derodontidae (fig. 12); there are no lateral ocelli and the ventral halves of the head capsule almost meet in a point immediately behind the labium (fig. 15); the clypeus is distinct and the labrum entire. The antennae are 3-segmented with the sensory appendage of the second segment situated antero-ventrally in relation to the third segment (fig. 16). The mandibles (fig. 14) have a large ridged molar part, a delicate slender prostheca, and a single apical tooth followed by a diminishing series of indistinct teeth along their inner face; there is no accessory ventral condyle. The maxillae have a fairly large articulating area (fig. 15), a well-developed undivided cardo, an undivided stipes bearing a 3-segmented palp with a small palpiger, and the apex divided into two points (? galea and lacinia); there is a small tuft of serrate hairs on the outer dorsal face of the galea. The labium has a characteristically-shaped mentum (fig. 15); the prementum is small, bearing well-separated 2-segmented palpi and a distinct bilobed ligula. The hypopharyngeal sclerome is heavily sclerotised and characteristic (fig. 17). The tergites of the thorax and abdominal segments 1–9 are strongly sclerotised and approximately semi-circular in cross-section; that of the prothorax is considerably longer than the others and more or less quadrate, the others being markedly transverse. Abdominal tergites 1–8 bear the spiracles, which are simple and annular, a little above their lateral edges. The ninth tergite is produced into characteristic urogomphi (fig. 13); the tenth segment is ventrally placed and surrounded by a ring-shaped sclerome. The thoracic tergites have a distinct median pale line, the meso- and meta-thoracic and abdominal ones have each a crenulate transverse ridge near their anterior margins; the disc of all the tergites is rather dull and distinctly shagreened, their front and hind margins more shining. The ventral side of the thorax and of the first eight abdominal segments is completely membranous. The anterior spiracles are situated in the membrane on the lower anterior side of the mesothorax, and are annuliform like the others. The legs are short and fairly stout, the femora and tibiae being only slightly longer than their maximum width; the tarsungulus is claw-shaped with a broad base and a single short stout spine near its base ventrally. The gut appears to have a single long loop in the abdomen, and is full of granular material.

III. Revised Key to the Families of Dermestoidea

1 Adult: front coxae strongly transverse, not at all projecting, their cavities completely open behind, no trace of post-coxal hypomeral



FIGS. 12–17.—*Saphophagus minutus* Sharp. Larva: (12) frontal sutures; (13) end of abdomen, ventral view; (14) right mandible, ventral view; (15) right maxilla and labium, ventral view; (16) left antenna, ventral view; (17) hypopharyngeal sclerome. (*9S*, sternite of ninth abdominal segment; *10S*, abdominal segment 10; *9T*, tergite of ninth abdominal segment; *SA*, sensory appendage of antennal segment 2.)

processes; tip of the prosternal process received in mesosternum; middle coxae widely separated, hind coxae almost contiguous, excavate; head without dorsal ocelli. LARVA: eighth abdominal segment terminal, elongate, bearing the contiguous spiracles at its apex; mandible with accessory ventral condyle . . . 2. NOSODENDRIDAE

– ADULT: front coxal cavities rarely completely open behind, if so front coxae much less transverse or distinctly projecting; if tip of prosternal process received in mesosternum, head with dorsal ocellus. LARVA: eighth abdominal segment not terminal, its spiracles lateral; mandibles without accessory ventral condyle 2

2 ADULT: front coxal cavities not apparently closed behind; metasternum of normal length, without distinct transverse suture. LARVA: head with distinct median epicranial suture; mandibles rarely with distinct molar part, maxillary lacinia spur-like at apex . 3

– ADULT: front coxal cavities completely closed behind; metasternum very long, or with a distinct transverse suture in its posterior part. LARVA: head without median epicranial suture; mandibles usually with distinct molar part; maxillary lacinia not spur-like 4

3 ADULT: hind coxae excavate, or head with median ocellus, hind coxae practically contiguous; trochanters normal. LARVA: head with distinct ocelli; body bearing specialised setae, or mandibles with distinct molar part . . . . . 3. DERMESTIDAE

– ADULT: hind coxae widely separated, not distinctly excavate; head without ocellus; trochanters elongate. LARVA: head without ocelli; body without specialised setae, mandibles without molar part 4. THORICTIDAE

4 ADULT: hind coxae excavate; metasternum not unusually long, narrowed in front, the metepisterna almost reaching middle coxal cavities, sternum with a distinct transverse suture posteriorly; head with 2 dorsal ocelli or ocellus-like tubercles. LARVA: spiracles bicameral; ligula not bilobed; maxillary galea without a tuft of serrate setae 1. DERODONTIDAE

– ADULT: hind coxae not excavate; metasternum very long, parallel-sided, its episterna very narrow, sternum without distinct transverse suture; head without dorsal ocelli or ocellus-like tubercles. LARVA: spiracles annuliform; ligula bilobed; maxillary galea with a tuft of serrate setae . . . . . 5. SAROTHRIIDAE

IV. REVISED DEFINITION OF THE DERMESTOIDEA

Polyphagan beetles.

Adult: antennae always more or less clavate. Hind coxae usually (except in Sarothriidae and Thoractidae) excavate. Wing-venation usually of Cantharoid type with short radial cell (approximating to Staphylinoid type in Sarothriidae), folding of Clavicorn or Bostrychoid type. Elytra, if striate, with a scutellary striole. Abdomen (except in *Thylodrias*) with 5 visible sternites, all free; eighth abdominal tergite exposed in both sexes, its spiracles well developed. Metendosternite with a distinct median stalk (except in *Sarothrias*), never Hylecoetoid. Aedeagus of more or less modified trilobe type, never Cucujoid. Ovipositor of female short, without baculi, with all the normal parts. Malpighian tubules 6, their ends free or (in Dermestidae only) attached to one side of hind gut as in Bostrychoidea. Prothorax never of Bostrychoid type.

Larva: maxillae with well-developed articulating area (reduced in *Laricobius*), galea and lacinia distinct, the former 1-segmented, not finger-like, the latter often with a spur-

like point. Mandibles stout, with or without molar part. Labrum free. Usually 5 or 6 ocelli on each side. Spiracles annular or bicameral, internally with a normal closing apparatus. Abdominal segments 1–7 with well sclerotised tergites and soft membranous under surface; tergite 9 sometimes with horny processes but never with articulated urogomphi. Antennae 3-segmented with the sensory appendage of segment 2 situated antero-ventrally of segment 3. First instar larva with cephalic (*Laricobius*) or no (*Anthrenus, Dermestes*) egg-bursters.

V. The Relationships of the Dermestoidea

If the characterisation of the superfamily is considered critically, it will appear that none of its basic characteristics can be said with any certainty to be derivative in relation to the fundamental Polyphagan type. One feature designedly omitted in the definition is the structure of the base of the abdomen—is it to be described as Haplogastran or Symphiogastran? In the disarticulated abdomen of all the Dermestoidea examined by me, the second (morphological) abdominal sternite is represented by a distinct median sclerotised piece (lying anterodorsally to the inter-coxal process of the third sternite), with lateral more membranous parts separated from the true third sternite by a more or less distinct line, and at the lateral ends there is usually a rather more sclerotised part more or less in the position of the pleurite of typical Haplogastra. This is very similar to the condition in many Staphyliniformia, *e.g.* Hydraenidae, and incidentally not very different from that in Cupedidae; it might well correspond to that in ancestral Polyphaga, the more pronounced Haplogastran conditions being then secondary. Another differentiating feature of the Staphyliniformia which is commonly regarded as primitive for the Polyphaga (and for the Coleoptera as a whole) is the presence of articulated urogomphi on the ninth tergite of the larva. Yet such appendages on the ninth segment are not found at any stage in *Cupes* or *Micromalthus*, nor in most Geodephaga, nor in the only known Myxophagan larva (that of *Hydroscapha*), nor in such primitive Polyphagan types as *Calyptomerus*, *Clambus*, *Eucinetus* or the Derodontidae. Articulated appendages in this position are likewise not found in other primitive Endopterygote larvae. If various other articulated and musculated appendages on abdominal segments in Endopterygote larvae (e.g. *Sialis* and the Gyrinidae) are regarded as secondarily developed, why should not the urogomphi be similarly regarded? If articulated urogomphi are indeed a derivative feature, then they provide (what is otherwise lacking) a satisfactory character for separating the Staphyliniformia from other Polyphaga. The most likely of the Dermestoid characters to be derivative is perhaps the distribution of sclerotisation in the larva. In most other Coleoptera, where the tergites are sclerotised the sternites are also evidently sclerotised—though usually considerably less so than the tergites. In other Coleoptera, the Dermestoid condition is most closely approached in some of the Cucujoidea—and there are reasons for suspecting that the Cucujoids themselves may be ultimately derivable from Dermestoid ancestors.

There are good grounds for supposing that the Dermestoids have given rise to another important superfamily—the Bostrychoidea (*see*, for example, van Emden, 1951). The Bostrychoids might be described as Dermestoidea profoundly modified for a wood-boring mode of life, the modifications affecting particularly the head and thorax and ovipositor of the adult, and the more

obvious feature of the larva. The type of cryptonephridic Malpighian tubules found in the Bostrychoidea is characteristic of the Dermestidae, and the basic Bostrychoid type of aedeagus is close to that of the same family.

The Dermestoidea provide likely ancestors also for the enormous complex of the Cucujiformia mihi (Cleroidea, Lymexyloidea, Cucujoidea, Chrysomeloidea, Curculionoidea and probably Stylopoidea). The basic Cucujiform type differs from the Dermestoidea in the adult by lacking the spiracles on abdominal segment 8, by the non-excavate hind coxae, by the Cucujoid aedeagus and the Hylecoetoid metendosternite; in the larva it differs chiefly in having an undivided maxillary mala and probably some degree of sclerotisation of the abdominal sternites. The ancestral Cucujoid doubtless had the ends of the Malpighian tubules attached symmetrically round the hind gut, a condition not yet known to occur in the Dermestoidea (though the condition of the tubules in Sarothriidae has not so far been investigated). The genus *Saphophagus* is of particular interest in that it has hind coxae essentially like those of Cucujiformia and a metendosternite (fig. 11) which comes closer to the type found in the lower Cucujoidea than does anything else known to me outside the Cucujiformia. There is at present no evident reason why the Cucujiformia should not have been derived from a Dermestoid ancestor more or less related to *Saphophagus*.

A more difficult and obscure, but highly interesting, question concerns the relationship between Dermestoidea and the rather heterogeneous group of families formerly placed by me in Dascilloidea—the Clambidae, Eucinetidae, Helodidae and Dascillidae. It is difficult to point to any basic and consistent difference between the two groups, except the distribution of sclerotisation in the larva (in the Dascilloidea, where the abdominal tergites are sclerotised, the sternites are likewise). The antennae are clubbed in Dermestoidea—but also in Clambidae; the larval spiracles are annular in most Dascilloidea (cribriform in *Dascillus*) but also in *Saphophagus*; an " accessory ventral condyle " to the larval mandible is present in *Nosodendron*, *Dascillus*, Helodids and some *Eucinetus* (according to Boving and Craighead, 1931), but absent in other Dermestoidea, Clambidae and at least some *Eucinetus* (according to van Emden, *personal communication*); horny processes (urogomphi) on the ninth abdominal tergite of the larva are present in typical Dermestoidea but absent in *Nosodendron* and most Dermestidae, and also in the Dascilloidea. A normal closing apparatus following the atrium of the larval spiracles is present in all Dermestoidea, including the quasi-aquatic *Nosodendron* larva, absent in *Dascillus*, present in the terminal spiracles (the only functional ones) of Helodid larvae, present in the Clambidae and in *Eucinetus*. The absence of a typical closing apparatus to the larval spiracles is apparently characteristic of most of the Dascilliformia mihi, except the Dascilloidea, Buprestoidea and Eucnemidae-Trixagidae—*i.e.* of the superfamilies Byrrhoidea, Dryopoidea, Rhipiceroidea, most Elateroidea and Cantharoidea. There would be some justification for splitting the Dascilloidea, leaving Dascillidae (*s. str.*) alone in the superfamily and in the Dascilliformia, and erecting a new superfamily for Clambidae, Eucinetidae and perhaps Helodidae. This new superfamily would represent a very primitive Polyphagan stock, with probably a direct relationship to the Dermestoidea, and possibly ancestral to the Dascilliformia, Scarabaeiformia and even Staphyliniformia.

There are certain peculiar similarities which might lead one to suspect a direct relationship between the Dermestoidea and the Staphyliniformia. First, there is the presence of dorsal ocelli in these groups alone of the Coleoptera. Secondly, there is the previously mentioned structure of the base of the abdomen. Thirdly, there is the remarkable Staphylinoid-like fringe on the maxillary galea in the *Saphophagus* larva (fig. 15). Fourthly, the sensory appendage of antennal segment 2 has in the Dermestoidea the same relation to segment 3 as it has in the Staphylinoidea.

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